

TITLE PAGE

Acute vestibular migraine: a ghost diagnosis in patients with acute vertigo

Authors: Maria Francisca Rocha¹, Benjamin Sacks¹, Amira Al-Lamki², Nehzat Koohi^{1,2,3*}, Diego Kaski^{1,2,3*}

MR and BS are joint first authors. NK and DK are joint senior authors.

Affiliations:

1. Comprehensive Stroke Service, National Hospital for Neurology and Neurosurgery, Queen Square, London, UK
2. The Ear Institute, University College London, London, UK
3. Department of Clinical and Movement Neurosciences, Institute of Neurology, University College London, UK.

Correspondence author:

Professor Diego Kaski, Centre for Vestibular and Behavioural Neurosciences, Department of Clinical and Movement Neurosciences, UCL, 33 Queen Square, London WC1N 3BG

Tel: +44 20 3448 3135 Fax: +44 20 3448 4775 emails: d.kaski@ucl.ac.uk

Running title: acute vestibular migraine

Word count: abstract 215

Main body 1498

References 15

Keywords: Acute vertigo; vestibular migraines; emergency department; dizziness; BPPV

ABSTRACT

INTRODUCTION

Vestibular migraine (VM) is an increasingly recognised cause of acute vertigo but has been conspicuously absent from many acute vertigo studies because its diagnosis can only be made in the chronic phase with five or more episodes of vertigo. Delayed diagnosis can have repercussions for patient outcomes. Following diagnosis, reassurance, patient education, and timely treatment could mitigate the development of more persistent dizziness in these patients. Herein, we evaluate and compare the assessment and diagnosis of patients with acute vertigo, between non-specialist clinicians and acute vertigo specialists, with a focus on VM.

METHODS

Retrospective case-note review of 106 consecutive dizzy patients who were seen in an 'acute vertigo service' outpatient clinic within two weeks of symptom onset. We reviewed the age at presentation, gender, phenotype of initial presentation, examination findings and diagnoses of referring clinicians and acute vertigo specialists.

RESULTS

Of 106 patients, thirty-one patients (29%) had a working diagnosis of VM made by the specialists. Only 10 (9%) were suspected to have VM by non-specialist referring clinicians, of whom just four also had a working diagnosis of VM by the specialists.

CONCLUSION

Our findings highlight the need for improved diagnostic criteria for diagnosis of acute VM to allow non-specialists to make a working diagnosis where other central pathologies have been excluded.

INTRODUCTION

Acute vertigo is a common presenting symptom in both primary and secondary care^{1,2}, with a wide differential diagnosis that makes this symptom diagnostically complex. Acute vertigo assessment therefore remains a diagnostic challenge for non-specialist clinicians³.

One of the most important aims of acute vertigo assessment is to distinguish between peripheral and central causes, the key to which lies in a focused history and clinical examination. To address this need, the 'HINTS-plus' examination was introduced as a simple method that focused on the vestibulo-ocular reflex (VOR), nystagmus, skew deviation, and identification of unilateral or asymmetrical hearing loss able to correctly identify stroke as a cause of acute vertigo with high sensitivity and specificity⁴ in patients with an acute vestibular syndrome. Later, several other diagnostic algorithms, focusing on eye movements (STANDING) or history (TITRATE, ATTEST) have been proposed⁵. While these diagnostic algorithms concentrate on either identifying central causes of vertigo such as stroke, or diagnosing peripheral vestibular disorders, there are currently no validated diagnostic approaches identifying patients with more benign (and common) central cause of vertigo such as a vestibular migraine (VM).

Vestibular migraine is defined by recurrent episodes of vestibular symptoms accompanied by migraine features (e.g., photophobia, phonophobia, motion intolerance), with or without headaches. In the chronic phase, VM may be difficult to differentiate from other vestibular disorders, such as Meniere's disease, for which dedicated audiovestibular investigations may be required^{6,7}. VM is however an increasingly recognised cause of acute vertigo⁶ but has been conspicuously absent from many acute vertigo studies. Indeed, following a first ever presentation of vertigo (without a history of multiple episodes), it is often challenging to differentiate acute VM from other causes of acute vertigo, such as stroke, given a similar presenting symptom complex (vertigo, vomiting, headache, and gait ataxia). MRI brain scan in these patients is normal which makes the distinction from image-negative posterior circulation stroke extremely challenging⁸. Furthermore, in some patients acute VM is associated with positional nystagmus features that resemble benign paroxysmal positional vertigo (BPPV) this mimicking a peripheral disorder⁹.

Misclassification of the signs and symptoms in acute vertigo patients presenting to the ED may potentially result in diagnostic error. Identifying the clinical features of VM in patients without the history of multiple episodes, could facilitate early recognition of this common and benign condition. It would also obviate the need for additional investigations and referrals, and would allow diagnosis to be reached faster, with potential longer-term benefits for patient outcomes.

Here, we analyse and compare the assessment and working diagnosis of patients with acute vertigo, between non-specialist clinicians and neuro-otology specialists, with a focus on VM. We sought to establish the frequency of possible acute VM in an acute vertigo service setting.

METHODS

This is a retrospective case-note review of patients with dizziness who were seen in an 'acute vertigo service' service. This review is part of an ongoing study of acute vertigo in the emergency department (REC 21/NW/0015). Inclusion criteria include adult (>18years) patients with a presentation of acute vertigo, dizziness, imbalance, or a gait disorder (assessed less than 2 weeks from symptom onset) as the primary complaint, with or without a previous history of vestibular disorders. Exclusion criteria were dizziness, vertigo, or unsteadiness as a *secondary* symptom and severe cognitive impairment. The acute vertigo clinic is based at a tertiary neurology centre (National Hospital for Neurology and Neurosurgery) in London, United Kingdom (UK) and led by two of the authors (DK, NK). Patients are seen within two weeks of symptom onset.

One hundred and six (106) consecutive patients meeting the inclusion criteria over a period of 12 months (December 2021 to December 2022) were included in the study. Referring clinicians comprised acute medicine (n=10, 9%), emergency department (n=50, 47%), emergency referrals from general practitioners (n=7, 7%) and medical specialists other than neuro-otology (n=39, 37%). Demographic and clinical data were obtained from clinical records. We reviewed the age at presentation, gender, phenotype of initial presentation (vertigo, dizziness, imbalance, gait disorder), examination findings and diagnoses of referring clinicians and acute vertigo specialists. Acute vertigo specialists were a Neurologist (DK) with expertise in neuro-otology, and a Clinical Scientist in Neuro-audiology (NK) with expertise in audiovestibular science, with a combined experience of over 20 years in the field.

Final clinical diagnoses, made by the acute vertigo specialists (DK and NK), were based on the diagnostic criteria ratified by the committee of the International Classification of Vestibular Disorders (ICVD), of the Bárány Society¹⁰. For the purpose of this study, patients with less than five episodes of vertigo or dizziness but who otherwise fulfilled criteria for definite VM were classified as having a 'working' diagnosis of VM. All patients underwent detailed neurological (including gait) and neuro-otological assessments and - where relevant - HINTS-plus and Dix-Hallpike assessments when reviewed by the specialist team. Strokes were diagnosed in patients with convincing clinical features and corresponding DWI lesions on MRI.

RESULTS

Of the 106 patients included in the study, 49 were male and 57 were female. The mean age at presentation was 54.8 +/-16.4 years (57 +/- 16.6 years for male and 53.5 +/- 16.4 years for female). Of these 106 patients, thirty-one patients (29%) had a 'working diagnosis' of VM made by the specialists. Only 10 (9%) were suspected to have VM by non-specialist referring clinicians, of whom four were confirmed to have a 'working diagnosis' of VM by the specialists.

Of the patients with VM diagnoses in acute vertigo clinic (n=31), 24 were female (mean age 55.3 +/- 14.4 years) and seven were male (mean age 39.8 +/-15.3 years). Dix-Hallpike and the vestibulo-ocular reflex gain (measured using video head impulse test) were normal in 87% (n=27) and 94% (n=29), respectively. 87% (n=27) of patients with VM diagnoses were asked about motion sensitivity. Of these, 100% said they had experienced nausea or vomiting when reading in the passenger seat of a car. Other symptoms included headache (55%; n=17), photophobia (45%; n=14), nausea/vomiting (52%; n=16), and oscillopsia (29%; n=9) during the dizziness episode.

In 106 patients with acute vertigo, one of the commonest referring diagnoses was 'no diagnosis/unspecified' (45%; n=48), of which 33% (n=16) were identified as having a working diagnosis of VM by specialists (Figure 1). 6% (2 out of 31; Figure 1) of patients subsequently diagnosed with VM by specialists were initially diagnosed with stroke.

DISCUSSION

We probed a retrospective dataset of patients referred to an acute vertigo service in the UK to evaluate the diagnostic accuracy of non-specialist clinicians in comparison to experienced specialists (neuro-otology and neuro-audiology clinicians) in patients presenting with acute vertigo. Our analysis focused specifically on a working diagnosis of vestibular migraine because of a relative lack of studies exploring this common disorder in the acute phase. In our dataset, two patients with vestibular migraine were originally misdiagnosed as having an acute stroke. Conversely, of the 31 patients with a working diagnosis of VM, in only 4 patients was this diagnosis suspected by non-specialist clinicians.

VM is thought to be the most common cause of spontaneous (non-positional) episodic vertigo, affecting up to 1% of the population^{11,12}. It is often misdiagnosed due to its overlap with other conditions that also cause vertigo, such as Meniere's disease, BPPV, and stroke⁶. The diagnosis of vestibular migraine requires at least five episodes of vertigo of moderate or severe intensity, current or previous history of migraine, and one or more migraine features with at least half of the vestibular episodes¹⁰. A major diagnostic challenge in the acute setting is a patient with the first (or first few) attacks of vestibular migraine, where a history may be supportive, but the diagnostic criteria are not strictly met. We explicitly adopted a more liberal diagnostic criteria to identify the proportion of patients in whom VM criteria were met, but where there may not have been sufficient previous attacks to make a formal diagnosis. Indeed, there were no patients presenting with VM who fulfilled the strict criteria, perhaps because such patients may have already had a formal diagnosis, therefore not requiring emergency review, or because the patient recognises the nature of the symptoms, and that these will settle spontaneously. Either way, this means that VM is unlikely to be diagnosed in patients with acute vertigo, accounting for the low suspicion rate among non-specialists. This has important implications for acute vertigo management; it is well-established that incorrect diagnosis leads to poorer long-term outcome for patients¹³, increasing the potential for conversion into persistent dizziness (persistent-postural perceptual dizziness)¹⁴. Moreover, patients may be exposed to inappropriate investigations (CT head, MRI), increased length of stay, or therapies that may exacerbate symptoms (e.g., repositioning manoeuvres where BPPV is erroneously suspected). A working diagnosis of VM may not negate the need for acute imaging to exclude

a vascular cause (VM is after all a central vestibulopathy), but its recognition once other acute causes have been excluded can be of reassurance, allow instigation of abortive therapies, lifestyle changes, and discussion of availability of preventative approaches¹⁵.

Our findings highlight the high prevalence of acute vestibular migraine in an acute vertigo clinical setting. Updated diagnostic criteria may be required for acute vestibular migraine, where a working diagnosis could be made with less than five episodes where there are sufficient accompanying features to support the diagnosis, particularly in the presence of normal imaging.

ACKNOWLEDGEMENTS

We are grateful to our patients. We would like to thank our Emergency Department and Same Day Emergency Care colleagues at the University College London Hospitals. DK received grant from the Meniere's Society and NK received grant from the National Institute for Health Research (HEE/NIHR ICA Programme Clinical Lectureship NIHR302201).

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

FUNDING

DK declares grant from the Meniere's Society and NK declares grant from the National Institute for Health Research (HEE/NIHR ICA Programme Clinical Lectureship NIHR302201).

WB, SH, MB, AAM, AC and RS declare no competing interests.

REFERENCES

1. Yardley L, Owen N, Nazareth I, Luxon L. Prevalence and presentation of dizziness in a general practice community sample of working age people. *Br J Gen Pract.* 1998 Apr;48(429):1131-5. PMID: 9667086; PMCID: PMC1410052.
2. Cutfield NJ, Seemungal BM, Millington H, Bronstein AM. Diagnosis of acute vertigo in the emergency department. *Emerg Med J.* 2011 Jun;28(6):538-9. doi: 10.1136/emj.2010.105874. Epub 2011 Mar 12. PMID: 21398692.
3. Dumitrascu OM, Torbati S, Tighiouart M, Newman-Toker DE, Song SS. Pitfalls and rewards for implementing ocular motor testing in acute vestibular syndrome: A Pilot Project. *Neurologist.* 2017;22(2):44–47. pmid:28248913.
4. Kattah, J.C., Talkad, A.V., Wang, D.Z. et al. H.I.N.T.S to Diagnose Stroke in the Acute Vestibular Syndrome – Three-Step Bedside Oculomotor Exam More Sensitive than Early MRI DWI. 2009 Nov;40(11):3504-10. doi: 10.1161/STROKEAHA.109.551234. Epub 2009 Sep 17. PMID: 19762709; PMCID: PMC4593511.
5. Nakatsuka M, Molloy EE. The HINTS examination and STANDING algorithm in acute vestibular syndrome: A systematic review and meta-analysis involving frontline point-of-care emergency physicians. *PLoS One* 2022;17:e0266252
6. Seemungal B, Kaski D, Lopez-Escamez JA. Early Diagnosis and Management of Acute Vertigo from Vestibular Migraine and Ménière's Disease. *Neurol Clin.* 2015 Aug;33(3):619-28, ix. doi: 10.1016/j.ncl.2015.04.008. Epub 2015 Jun 12. PMID: 26231275.
7. Chen JY, Guo ZQ, Wang J, Liu D, Tian E, Guo JQ, Kong WJ, Zhang SL. Vestibular migraine or Meniere's disease: a diagnostic dilemma. *J Neurol.* 2023 Apr;270(4):1955-1968. doi: 10.1007/s00415-022-11532-x.
8. Bulut HT, Yildirim A, Ekmekci B, Eskut N, Gunbey HP. False-negative diffusion-weighted imaging in acute stroke and its frequency in anterior and posterior circulation ischemia. *J Comput Assist Tomogr.* 2014 Sep-Oct;38(5):627-33. doi: 10.1097/RCT.0000000000000095. PMID: 24879456.

9. Von Brevern M, Zeise D, Neuhauser H, Clarke AH, Lempert T. Acute migrainous vertigo: clinical and oculographic findings. *Brain*. 2005 Feb;128(Pt 2):365-74. doi: 10.1093/brain/awh351. Epub 2004 Dec 15. PMID: 15601663.
10. Lempert T, Olesen J, Furman J, Waterston J, Seemungal B, Carey J, Bisdorff A, Versino M, Evers S, Kheradmand A, Newman-Toker D. Vestibular migraine: Diagnostic criteria1. *J Vestib Res*. 2022;32(1):1-6. doi: 10.3233/VES-201644. PMID: 34719447; PMCID: PMC9249276.
11. Lempert T, von Brevern M. Vestibular Migraine. *Neurol Clin*. 2019 Nov;37(4):695-706. doi: 10.1016/j.ncl.2019.06.003. Epub 2019 Aug 20. PMID: 31563227.
12. Smyth D, Britton Z, Murdin L, Arshad Q, Kaski D. Vestibular migraine treatment: a comprehensive practical review. *Brain*. 2022 Nov 21;145(11):3741-3754. doi: 10.1093/brain/awac264. PMID: 35859353; PMCID: PMC9679161.
13. von Brevern M, Lempert T. Vestibular Migraine: Treatment and Prognosis. *Semin Neurol*. 2020 Feb;40(1):83-86. doi: 10.1055/s-0039-3402067. Epub 2019 Dec 30. PMID: 31887753.
14. Popkirov S, Staab JP, Stone J. Persistent postural-perceptual dizziness (PPPD): a common, characteristic and treatable cause of chronic dizziness. *Pract Neurol*. 2018 Feb;18(1):5-13. doi: 10.1136/practneurol-2017-001809. Epub 2017 Dec 5. PMID: 29208729.
15. Shen Y, Qi X. Update on diagnosis and differential diagnosis of vestibular migraine. *Neurol Sci*. 2022 Mar;43(3):1659-1666. doi: 10.1007/s10072-022-05872-9. Epub 2022 Jan 11. PMID: 35015204.

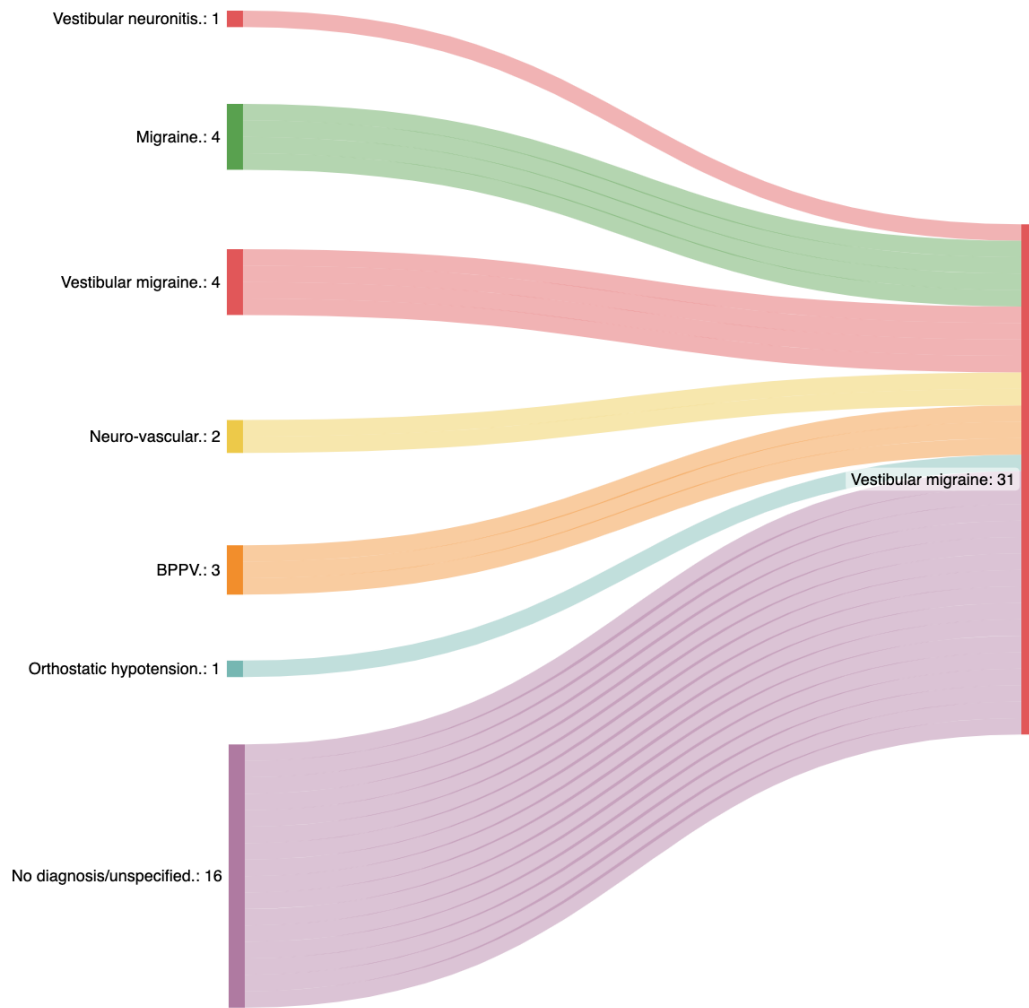


Figure 1. Sankey diagram illustrating the diagnoses made by the referring clinicians (left) for patients that were eventually diagnosed with vestibular migraine by specialists (right).